

WHAT IS CLAIMED IS:

1. A phosphorus-containing solution comprising a mixture of salts and a carrier fluid, the salts comprising:

[Y]H<sub>2</sub>PO<sub>4</sub>; and

5 [Y]<sub>2</sub>HPO<sub>4</sub>, where [Y] is a cation,

the carrier fluid being operable to maintain the salts within the carrier fluid in at least a partially dispersed state, the phosphorus-containing solution being operable to create a phosphate-metal layer on a metal substrate when the phosphorus-containing solution is placed in contact with the metal substrate, the phosphorus-containing solution being essentially free of zinc and the mixture to form the phosphorus-containing solution being mixed in the absence of a highly exothermic reaction.

10 2. The phosphorus-containing solution of claim 1 further comprising [NR<sub>4</sub>]<sub>2</sub>HPO<sub>4</sub> wherein R is selected from the group consisting of hydrogen, alkyl groups and combinations thereof.

15 3. The phosphorus-containing solution of claim 2 wherein substantially no free ammonia is present.

4. The phosphorus-containing solution of claim 1 further comprising [X]C<sub>2</sub>H<sub>3</sub>O<sub>2</sub> where C<sub>2</sub>H<sub>3</sub>O<sub>2</sub> is an acetate group and [X] is a cation.

5. The phosphorus-containing solution of claim 4 wherein [X] is selected from the group consisting of potassium, NH<sub>4</sub>, and combinations thereof.

20 6. The phosphorus-containing solution of claim 1 wherein the pH of the phosphorus-containing solution is between about 6.0 and 8.0.

7. The phosphorus-containing solution of claim 1 wherein Y in [Y]H<sub>2</sub>PO<sub>4</sub> is potassium.

8. The phosphorus-containing solution of claim 1 wherein Y in [Y]<sub>2</sub>HPO<sub>4</sub> is potassium.

9. The phosphorus-containing solution of claim 1 wherein Y in  $[Y]H_2PO_4$  and  $[Y]_2HPO_4$  is selected from alkali metals.
10. The phosphorus-containing solution of claim 1 further comprising a dispersant.
11. The phosphorus-containing solution of claim 1 further comprising a target fluid such that  
5 the target fluid is operable to bring the phosphorus-containing solution into contact with metal.
12. The phosphorus-containing solution of claim 11 wherein the target fluid is a lubricating fluid.
13. The phosphorus-containing solution of claim 1 wherein the metal substrate comprises at least part of an engine
- 10 14. A process for creating a phosphate-metal layer on a metal substrate where the metal substrate is in at least partial contact with a target fluid, the process comprising adding an amount of the phosphorus-containing solution of claim 1 to the target fluid effective to create the phosphate-metal layer, the target fluid combined with the phosphorus-containing solution being brought into contact with the metal substrate such that the phosphate-metal layer results on the  
15 metal substrate.
15. The process of claim 14 wherein the phosphorus-containing solution further comprises  $[NR_4]_2HPO_4$  wherein R is selected from the group consisting of hydrogen, alkyl groups and combinations thereof.
16. The process of claim 15 wherein the phosphorus-containing solution further comprises  
20  $NH_4C_2H_3O_2$  where  $C_2H_3O_2$  is an acetate group.
17. The process of claim 16 wherein the pH of the phosphorus-containing solution is between about 6.0 and 8.0.
18. The process of claim 14 wherein the Y in  $[Y]H_2PO_4$  in the phosphorus-containing solution is potassium.

19. The process of claim 14 wherein the Y in  $[Y]_2HPO_4$  in the phosphorus-containing solution is potassium.
20. The process of claim 14 wherein the target fluid is selected from the group consisting of lubricating fluid or phosphating bath.
- 5 21. A converted metal substrate including a phosphate-metal layer created by the process of claim 14 forming a conversion surface on a metal substrate.
22. The converted metal substrate of claim 21 wherein the metal substrate comprises iron.
23. The converted metal substrate of claim 21 wherein the metal substrate comprises a non-ferrous metal.
- 10 24. The converted metal substrate of claim 23 wherein the non-ferrous metal is aluminum.
25. The converted metal substrate of claim 20 wherein the metal substrate is at least part of an engine.
26. A lubricating composition comprising  
a substantial amount of an oil having a lubricating viscosity, and an amount of the  
15 phosphorus-containing solution of claim 1 operable to create a phosphate-metal layer upon a metal component upon being brought into contact with the metal component.
27. The lubricating composition of claim 26 wherein phosphorus is present in the lubricating composition in an amount of between about 300 ppm and 1250 ppm.
- 20 28. A method of lubricating an internal combustion engine, comprising supplying to the engine the lubricating composition of claim 26.
29. A method of forming a non-ferrous metal-phosphate conversion surface on a non-ferrous metal components, the method comprising the steps of:

preparing an active phosphorus solution by mixing a phosphorus-containing acid with an alkali metal hydroxide salt and an ammonium/amine compound to create an exothermic reaction thereby producing the active phosphorus-solution; and

5       contacting the non-ferrous metal component with the active phosphorus solution in a contact region on the non-ferrous metal component to form the non-ferrous metal-phosphate conversion surface on the contact region.

30.      The method of claim 29 wherein the non-ferrous metal component comprises aluminum.

31.      The method of claim 30 wherein the non-ferrous metal component comprises at least part of an engine.

10     32.      The method of claim 29 wherein the active phosphorus solution is delivered into contact with the non-ferrous metal in a lubricating environment using a lubricating fluid.

33.      A phosphate-metal layer for aluminum components, the surface comprising:

aluminum phosphate; and

15     aluminum oxide, the aluminum phosphate and aluminum oxide forming the phosphate-metal layer on an aluminum component, the phosphate-metal layer being formed as a result of contacting the aluminum component with an amount of a phosphorous-containing solution of claim 1 operable to create the phosphate-metal layer.